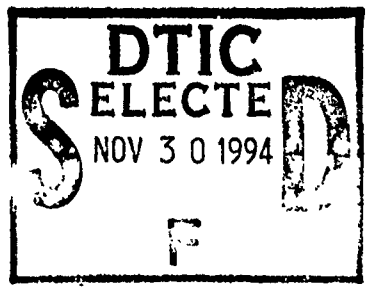

QUARTERLY REPORT

REPORT TYPE (A)

CONTRACT/GRANT NUMBER: N0001492J1308

PRINCIPAL INVESTIGATOR: DR. RALPH J. JACCODINE

SHERMAN FAIRCHILD LABORATORY

LEHIGH UNIVERSITY

BETHLEHEM, PA 18015

OFFICE OF NAVAL RESEARCH PROGRESS REPORT

CONTRACT NO. N0001492J1308

QUARTERLY REPORT

Research has begun on SiGe oxidation in situ in a UHV chamber with high resolution XPS. In this phase of the work, the early stages of oxidation are being studied as a chemisorbed layer of oxygen on clean silicon (100) is converted to a thin (<5 nm) oxide layer. We have observed that the native oxide on SiGe alloys contains Ge suboxides as revealed in the curve-fitted angle-resolved spectra. This is consistent with preliminary observations made earlier in this laboratory. Electron beam heating is being used to initiate thermal oxidation. We have been able to heat samples to >900° C with excellent uniformity over a 1 cm^2 area. An optical pyrometer suitable for transmission through a quartz vacuum window was recently purchased and has been employed for temperature measurement. The sample surface is prepared either by HF etching or in situ sublimation of the native oxide. The surface condition is routinely checked by low-energy electron diffraction (LEED) before oxidation. In the first oxidation run, an oxygen pressure of $2x10^{-6}$ Torr at 910° C was used to form a thin layer of silicon suboxides on silicon.

The other phase of this work involves the growth of dry oxides in a state-of-the-art quartz-walled furnace using minute (parts per million) additions of fluorine to the oxidizing ambient. A mass flow controller (MFC), with all-metal seals and handling 10 sccm full scale, has recently been purchased and installed on the NF_3 line into our furnace. This should eliminate the particularly bothersome problem in the earlier flowmeter arrangement of a chemical reaction between the NF_3 and the ruby float in the flowmeter. The first oxidation run on SiGe films using the MFC has been conducted.

Our earlier work has demonstrated the beneficial effect of germanium at the Si-SiO_2 interface in reducing hot electron emission from the Si into SiO_2. This hot electron injection is a major concern for contemporary MOS device structures with a ultra short channel. An off setting result was the increase in the electron trapping rate due to the presence of Ge in the SiO_2. We observed that this increase does not occur if the Ge is implanted before the oxidation. However, the hot electron injection reduction was reduced. The reason for the lack of increased trapping might result from the Ge going into the Si instead of the oxide when the implantation is done before the oxidation. Another possibility might be that the Ge induced electron traps are due to the presence of partially oxidized Ge in the oxide. If this is the case, then the increased trapping might be reduced by subsequent oxidation treatments. We have experiments underway to investigate this possibility. Other experiments are planned to obtain profile measurements using SIMS of the Ge profile in the SiO_2 under the conditions of interest.